National Aeronautics and Space Administration
Goddard Space Flight Center
Contract No.NAS-5-3760

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ST - BTC - 10404

I S S L E D O V A N I Y A
K O S M I C H E S K O G O P R O S T R A N S T V A

[SPACE INVESTIGATIONS]

PREFACE
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Proceedings of the All-Union Conference on
Physics of Cosmic Rays

MOSCOW

10 - 16 June 1965

21 OCTOBER 1965

ST - BTC - 10404

I S S L E D O V A N I Y A
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(SPACE INVESTIGATIONS)

PREFACE

The first All-Union Conference on Space Physics took place in Moscow from 10 to 16 June 1965. Its main problem consisted in drawing a balance sheet of i vestigations conducted mainly with the help of rockets and artificial Earth's satellites.

The first in the World Earth's artificial satellite was launched in USSR on 4 October 1957. It laid the basis for direct human penetration into the depth of the Universe. Since then rocket flights to the Moon were materialized, piloted spaceships-satellites were launched and man's egress into space was achieved. These successes belong in the first place to our country. With the aid of the perfect sputniks of the 'Cosmos' and 'Electron' series and also other cosmic devices our scientists succeeded in obtaining numerous new and interesting results.

Nearly 100 reports (most manuscripts of which having been received in October-November 1964) were contributed. They encompassed most of the subdivisions of the multiple-branch area of space physics: upper atmosphere, ionosphere, radiation belts, interaction of solar corpuscular streams with the geomagnetic field, solar physics and physics of cosmic rays.

A series of experimental and theoretical reports drew the balance sheet of investigations of the Earth's upper atmosphere, its structure, dynamics and chemical composition.

Some of them were devoted to the study of infrared radiation of the Earth as well as of the upper atmosphere. The stratified distribution of atmosphere's infrared radiation intensity, heretofore unknown, was revealed in the 0.4 — 40 mk region of the spectrum with maxima

at 260, 420 and 500 km heights. Interesting data on lower atmosphere luminance and on the results of its analysis, obtained during the flights of spaceships Vostok and Voskhod, were communicated in reports drafted with the participation of cosmonauts Tereshkova-Nikolayeva and K. P. Feoktistov. It was assumed on the basis of these data that a dust cloud exists around the Earth at an altitude of $\sim$19 km.

The investigations of the ionosphere with the aid of mass-spectrometers, various types of probes and by radiomethods provided new information on the structure of the ionized regions of the outer ionosphere and on the electromagnetic events taking place in it. It was established, that above 1000 — 1200 km, the ionosphere consists mainly of protons — ionized hydrogen atoms. The ionized helium, earlier revealed in other experiments in the 700 — 1000 km altitude range, was observed in 1964 in insignificant amounts only, with the help of the scientific station Electron. During the examination of data of investigations in coherent frequencies emitted from AES, several maxima of electron concentration in the outer ionosphere were detected for a prolonged period of time; these are apparently conditioned by the complex horizontal-irregular structure of the ionosphere, by the dynamics of ionized particles, by plasma oscillations and similar phenomena. The mean altitude dependence of electron concentration in the outer ionosphere has been obtained; it does not reveal any peculiarities in the 1000 — 2000 km altitude range, earlier noted in other works.

Several reports were devoted to the theoretical consideration of of AES interaction with the ionosphere. The theory of kinetic flow past bodies in the plasma plays an important part in the investigations with the aid of AES. It allows to study the effects occurring in the vicinity of the body. Without accounting for these effects (angular distribution of particles, influence of the electric and magnetic fields) no correct interpretation of results is possible for a number of parameters of the unperturbed plasma. Friction of electromagnetic nature is also becoming noticeable at heights from 700 to 800 km and higher. The subsequent study of plasma stability in the vicinity of a moving body is important, just as is the creation of probe theory, taking into account the magnetic field.

Various results of measurements of the structure of the magnetosphere, radiation belts, Earth's magnetic field and corpuscular streams were reviewed in numerous reports. From the works presented it may be seen that there exists a close link between the behavior of radiation belts and a series of geophysical events, such as the variations of the Earth's magnetic field, the behavior of the polar ionosphere etc. ; at the same time, the amount of the experimental data presently available is still insufficient in spite of all its abundance and does not allow yet to compose a specific picture about radiation fields, radiation fluxes, surrounding the Earth. No somewhat complete and closed theory of these events exists as yet. The results of the various experiments still do not quite coincide and at times they diverge significantly.

Apparently the question of the nature and mechanisms of radiation belt formation will be reexamined in the very near future. An active trend is observed in trying to explain the structure of the belts by accounting for the dynamics of incident plasma fluxes in the Earth's magnetic field, of particle capture in the geomagnetic trap and their subsequent acceleration. From the energetic viewpoint such patterns do not encounter contradictions.

The fluxes of electrons, encountered in various experiments beyond the limits of the radiation belts at magnetosphere boundary, are noted in radiation zones trapped in the geomagnetic trap. This constitutes in some fashion the electron component of the plasma incident on Earth. The experimental data just as the general physical pattern of magnetosphere structure do not provide, however, any basis for the assumption of existence of still another, so-called outermost radiation belt.

The results of investigation of Sun's X-radiation, reported at the conference, create a rather clear picture about its properties and the energetic spectrum of this radiation in the period of the quiet Sun. A series of new data characterize the bursts of this radiation and their relationship with other events.

It is interesting that during the flares of cosmic rays, generated in the Sun, their intensity in the interplanetary medium increases at times even by hundreds and thousands.

Measurements of the intensity of cosmic radio emission on the scientific station Electron in the low-frequency wave band (725 and 1525 kc/s), which can be achieved only aboard satellites, lead to the detection of a series of interesting properties of this radiation, the nature of which will become understandable only in the future.

Investigation of cosmic rays on satellites allowed to obtain data on the chemical composition of their nuclear component, on the intensity of cosmic rays at various distances from the Sun etc. The possibility of study in the experiments of AES of processes induced by particles of very high energy, present in the composition of cosmic rays, and of search for fundamental elementary particles, in particular those forecast by the theory of the so called (..?....)*, that is, particles with a charge of one third to two-thirds of the electric charge of an electron are considered in one of the reports as one of the fundamental problems of future investigations.

The problems of meteorological satellites, of radiational security of space flights, of radiowave propagation to distances in millions of kilometers or at communication with cosmonauts, and a series of other questions, were all subjects of special reports.

During the latest years the scale and the span of investigations in the field of space physics have risen very strongly. At the same time, it is already impossible, at present, to be satisfied with the scale of standing investigations. The requirement is felt to improve the quality of experiments, to set up complex experiments and go deep into their analysis Required also is an accelerated development of planetary investigations with the aid of rockets, the broadening of experiments for the study of the recently discovered galactic γ- radiation. Of importance are the studies of spectra of interplanetary medium's and planet's natural electromagnetic radiation, and the solution of numerous other problems, which indeed are every day brought forth by space science. Search for more perfect and final theories of events studied is felt to be indispensable. The abundance of information which we obtain from expeirments with the aid of satellites and rockets, provides the basis to believe that the time

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* [equivalent of "kvarka" could not be found in any glossary or dictionary available]. — ?quark?

approaches, when one may be ready to undertake the creation of a new, more up-to-date and complete theory of Earth's atmosphere and ionosphere formation, to understand the dynamics of the interplanetary plasma, to create the theory of formation of the magnetosphere and of radiation belts and to explain the nature of numerous, most interesting events revealed in the Cosmos.

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Contract No. NAS-5-3760
Consultants & Designers, Inc.
Arlington, Virginia

Translated by ANDRE L. BRICHANT
on 20 and 21 October 1965

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